David L. Millman
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Education

Doctor of Philosophy candidate, Computer Science, University of North Carolina – Chapel Hill, Aug 2007 - Present
Advisor: Dr. Jack Snoeyink

Masters of Science, Computer Science, Courant Institute, New York University, May 2007
Thesis: Degeneracy Proof Predicates for the Additively Weighted Voronoi Diagram
Advisor: Dr. Chee Yap

Bachelors of Arts, Computer Science, Colgate University, May 2003
Honors in Computer Science, Dean's Award for Academic Excellence

Research Experience

Sept 2007–Present: Research Assistant of Dr. Jack Snoeyink
University of North Carolina-Chapel Hill, Chapel Hill, NC
Develop and implement practical and exact geometric algorithms that are robust to numerical inaccuracies by treating precision as a resource. Some applications include physical simulation, constructive solid geometry (CSG) image processing, post office queries, *k*-nearest neighbor queries for crystallographic symmetry groups, surface simplification of irregular terrain data and data structures for streaming input. Member of the Computational Geometry Group.

June 2010-August 2010: Internship at Bettis Atomic Power Laboratory
Bechtel Marine Propulsion Corporation, West Mifflin, Pa
Designed and implemented an algorithm for computing the volume of arbitrarily complex objects directly from their constructive solid geometry (CSG) representation. Considered multiple approaches such as sampling, octree decomposition, meshing and Collins decomposition; however, each approach was either too slow, required too much precision or created too much structure for applications involving a large number of 3d quadratic surfaces. The newly developed algorithm overcame these limitations. The algorithm directly processed the input surfaces, thereby avoiding the slow convergence of Monte Carlo and octree decomposition. In addition, the algorithm only resolves the topological features that significantly affect the volume; therefore, it does not require the height precision of meshing approaches. Finally, the algorithm is output sensitive, avoiding the exponential structure created by Collins decomposition. Development of the algorithm required the implementation of many geometry operations including: determining if two surfaces intersect and providing a point on the intersection curve when they do; numerically tracing the intersection curve of two quadric; updating the intersection of a half space defined by a quadric and a region approximated by a set of trimmed surface patches; and computing the volume under a surface patch.

May 2009-July 2009: Internship at Bettis Atomic Power Laboratory
Bechtel Marine Propulsion Corporation, West Mifflin, Pa
Derived and implemented a compact representation for objects defined by Boolean operations of implicit surfaces. This representation provides a reduced memory footprint and supports algorithms for rapidly evaluating the point inside/outside predicates. Applied advanced techniques from computational topology and numeric computational geometry to create a new, topologically consistent algorithm that ensures robust particle tracking in physical simulations without the need for exact arithmetic. The improved tracking algorithm was applied to a Monte Carlo radiation transport simulation and resulted in shorter simulation times with fewer lost particles, even for extremely complex model geometries.

June 2008–August 2008: Internship at Bettis Atomic Power Laboratory
Bechtel Bettis Inc, West Mifflin, Pa
Investigated convergence criteria, numerical stability and parameter optimization for an Arnoldi model reduction method for second order dynamical systems; Developed and tested a large scale, parallel implementation of this method using MATLAB's Distributed Computing Toolbox.

June 2007–August 2007: Internship sponsored by the NSF-IRES REUSSI program
National de Recherche en Informatique et Automatique, INRIA, Sophia-Antipolis, France
Started the parallel branch of Computational Geometry Algorithms Library (CGAL) as well as designed and implemented a parallel Delaunay triangulation algorithm as part of the Geometrica Group.

July 2006–July 2007: Student Employment NYU, advisor Dr. Panos Mavromatis Director of Music Theory
Steinhardt School of Education, New York University, New York
Creating user interface libraries to ease the creation of music applications and applying it to the development of an AI based tutor application to train composers in counterpoint techniques.

Feb 2006–July 2007: Exact Geometric Computation Lab, advisor Dr. Chee Yap
Courant Institute of Mathematical Sciences, New York University, New York
Assisted in the testing and debugging of CORE library v2.

May 2006–July 2006: Internship sponsored by the NSF-IRES REUSSI program
National de Recherche en Informatique et Automatique, INRIA, Sophia-Antipolis, France
Implemented predicates to reduce the algebraic degree of the Computational Geometry Algorithms Library (CGAL) implementation of the additively weighted Voronoi diagram as part of the Geometrica Group.

August 2003–October 2004: Research Assistant of Dr. James Abello
Center for Discrete Mathematics and Theoretical Computer Science, DIMACS, Rutgers University, Piscataway, NJ
Designed and implemented applications for use in the SEER Cancer data project; Investigated and implemented semi-external graph algorithms for processing graphs larger then 650,000 vertices and 6.5 million edges; Created applications for preprocessing SEER Cancer data for visualization.

January 2003–May 2003: Research Assistant of Dr. Thomas Parks
Colgate University, Hamilton, NY
Implemented algorithms in the java implementations of PN (Process Networks) and CSP (Communicating Sequential Processes) to demonstrate the scalability of the PN Framework as well as compare the performance of the two systems.

June 2001–August 2001: Research Assistant of MacArthur Fellow Dr. Gary Urton
Colgate University, Hamilton, NY
Investigated aspects of Incan culture and linguistic theory to assist in the design of a database of 23 Incan Quipus for use in understanding their communicative purpose.

Professional Experience

November 2004–May 2006: iPod Genius, Mac Specialist, ICS
Apple Computers Inc, SoHo, NY and Menlo Park, NJ
Prepared Early Field Failure Analysis on Nano and Version 5 (Video) iPods; Handled iPod related service issues; Presented GarageBand and iPod workshops; Installed airport, ram and video cards in Apple computers; Assisted customers with the purchase of Apple products; Worked with back of house issues such as inventory and product shrinkage avoidance.

April 2001–June 2003: Lab Administrator
Colgate Student Operated User Resource Center – SOURCe, Colgate University, Hamilton, NY
Managed a staff of six System Analysts; Advised Laboratory Manager on reoccurring system problems; Administered and performed upgrades and maintenance on all computers in all campus public laboratories; Provided technological assistance, computer repairs and upgrades for students.

Teaching Experience

August 2008–December 2008: Graduate Research Consultant for Intro to Scientific Programming
Provide course-based research opportunities for undergraduates by assisting students in writing proposals, research methods and techniques for communicating their findings to others.

August 2008–December 2008: TA for Intro to Scientific Programming
Lead recitation sections to assist with problems and answer questions for two sections of about 45 students per section; hold weekly office hours to aid students on an individualized basis; grade assignments and quizzes.

October 2006–May 2007: Private Tutor
Tutored masters students in algorithms; Assisted masters students in preparation for job and internship interviews.

September 1999–May 2005: Private Drum Teacher
Taught students ranging in age from 10–23 with skills of beginner to intermediate in drumming technique, reading, musicality and performance.

Honors and Awards

Academic

Department of Energy Rickover Fellowship, 2010 – Present – award from the Naval Reactors division of the U.S. Department of Energy (DOE) covers two full years of graduate study with a stipend.

Young Researchers Grant, 2010 – award from the SAGA Network to attend the Fall School on ShApes Geometry and Algebra located at Kolympari, Greece; covers registration, accommodation, board and 800 euro for travel.

Google Lime Scholarship, 2009 – award from Google and the Lime foundation, named 1 of 5 Google Lime scholars. Recipient of $10,000 academic scholarship and invited to all-expenses paid 2010 Google Scholars retreat at Google Headquarters in Mt. View, California.

Travel Grant, 2009, $400 from Tufts University to attend the 2009 Fall Workshop on Computational Geometry.

Travel Grant, 2008, $400 from Rensselaer Polytechnic Institute to attend the 2008 Fall Workshop on Computational Geometry

Travel Grant, 2008, $300 from Mathematical Association of America to attend Mathfest, 2008

Summer Research Grant, 2001 Summer stipend from the Colgate Division of Natural Sciences to assist in the creation of a database of 23 Incan Quipus for Anthropologic study.

Professional

Recipient of the Apple Best of Brand Award: Awarded to the Apple employee who most exemplifies the ideals of Apple as decided by co-workers, 2005.

Ranked #69 in Apple world wide sales performance, 2005.

Musical

Recorded drum set, percussion, electronics, vocals, arranged and co-wrote Defenestrate Time, “When We’re Alone”, released August 2007.

Recorded drum set on the EP, Wholesale, “Saying More by Saying Less” released Spring 1999 on Exit 6 records

Publications

David L. Millman, David P. Griesheimer, Brian R. Nease, and Jack Snoeyink. Robust Volume Calculations for Constructive Solid Geometry (CSG) Components in Monte Carlo Transport Calculations. To appear in *PHYSOR 2012: Advances in Reactor Physics*, 2012

David L. Millman and Vishal Verma. A slow algorithm for computing the Gabriel graph with double precision. In *CCCG ’11: Proceedings of the 23nd Canadian Conference on Computational Geometry*, pages 485-487, 2011.

David P. Griesheimer, David L. Millman, and Clarence R. Willis. Analysis of distances between inclusions in finite binary stochastic materials. *Journal of Quantitative Spectroscopy and Radiative Transfer in Journal of Quantitative Spectroscopy and Radiative Transfer*, 112(4):577–598, March 2011.

Brittany Terese Fasy and David L. Millman. Review of geometric algebra: an algebraic system for computer games and animation by J. Vince. *SIGACT News*, 42:46–48, March 2011.

Brittany Terese Fasy and David L. Millman. Review of geometric folding algorithms by authors: E.D. Demaine and J. O'Rourke. *SIGACT News*, 42:43–46, March 2011.

Matthew O'Meara, David L. Millman, Jack Snoeyink, and Vishal Verma. Maximum geodesic routing in the plane with obstacles. *CCCG '10: Proceedings of the 22nd Canadian Conference on Computational Geometry*, pages 107-108, 2010.

Vicente H.F. Batista, David L. Millman, Sylvain Pion, and Johannes Singler. Parallel geometric algorithms for multi-core computers. *Computational Geometry*, 43(8):663 – 677, 2010.

David L. Millman and Jack Snoeyink. Computing planar Voronoi diagrams in double precision: a further example of degree-driven algorithm design. In *SCG '10: Proceedings of the 26th Annual Symposium on Computational Geometry,* pages 386-392, New York, NY, USA, 2010. ACM.

David L. Millman and Jack Snoeyink. Computing the implicit Voronoi diagram in triple precision. In *WADS '09: Proceedings of the 11th International Symposium on Algorithms and Data Structures*, volume 5664 of *Lecture Notes in Computer Science*, pages 495–506. Springer, 2009.

Vicente H. F. Batista, David L. Millman, Sylvain Pion, and Johannes Singler. Parallel geometric algorithms for multi-core computers. In *SCG '09: Proceedings of the 25th Annual Symposium on Computational Geometry*, pages 217–226, New York, NY, USA, 2009. ACM.

David P. Griesheimer and David L. Millman. Analysis of distances between inclusions in finite one-dimensional binary stochastic materials. In *M&C '09: Proceedings of the International Conference on Mathematics, Computational Methods and Reactor Physics*. American Nuclear Society, American Nuclear Society, May 2009. electronic proceedings.

Vicente H. F. Batista, David L. Millman, Sylvain Pion, and Johannes Singler. Parallel multi-core geometric algorithms in CGAL. In *Workshop on Massively Multiprocessor and Multicore Computers*, 2009. electronic proceedings.

Brittany Terese Fasy and David L. Millman. Review of higher arithmetic: An algorithmic introduction to number theory by H. M. Edwards (American Mathematical Society Student Mathematical Library vol. 45, 2008). *SIGACT News*, 40(2):38–41, 2009.

Timothy M. Chan, David L. Millman and Jack Snoeyink. Discrete Voronoi Diagrams and Post Office Query Structures without the InCircle Predicate. In *FWCG '09: Proceedings of the Nineteenth Annual Fall Workshop on Computational Geometry*, pages 33–34, 2009.

David L. Millman and Jack Snoeyink. Degree-driven algorithm design for computing the Voronoi diagram. In *FWCG '08: Proceedings of the Eighteenth Annual Fall Workshop on Computational Geometry*, pages 20–21, 2008.

Vicente H. F. Batista, David L. Millman, Sylvain Pion, and Johannes Singler. Parallel geometric algorithms for multi-core computers. Research Report 6749, INRIA, 2008.

Brittany Terese Fasy and David L. Millman. Review of geometric algebra for computer science by Leo Dorst, Daniel Fontijne, and Stephen Mann (Morgan Kaufmann Publishers, 2007). *SIGACT News*, 39(4):27–30, 2008.

Presentations

David L. Millman, Degree-Driven Geometric Algorithm Design, Graduating Bits session at Innovations in Theoretical Computer Science, Cambridge, Ma, January 2012

David L. Millman, Approximate volumes of tremendous constructive solid geometry models. Poster presentation at Fall School on ShApes, Geometry and Algebra (SAGA), Kolympari, Greece, October 2010

David L. Millman, Two examples of degree-driven algorithm design, Guest lecture at The Institute of Science and Technology (IST) Austria in Maria Gugging, Austria, December 2009 and Duke University in Durham, NC February 2010

Brittany Terese Fasy and David L. Millman. Numerical issues in a geometric problem. Guest lecture at Duke University in Durham, NC, October 2008.

Brittany Terese Fasy and David L. Millman. Exploring computational mathematics: Unfolding polyhedra. Contributed paper session at MathFest in Madision, WI, August 2008.

David L. Millman. Lower degree predicates for the additively weighted voronoi diagram. Poster presentation at Mathematic Association of America, Mathfest in Madision, WI, August 2008.

David L. Millman. Streaming processing of spatial data. Presentation at University Research Day 2008, Chapel Hill, NC, March 2008.

David L. Millman. A parallel Delaunay triangulation algorithm for CGAL. Presentation at REUSSI Seminar 2007, INRIA-Rocqencort and Geometricia group, INRIA-Sophia-Antipolis, France, June and July 2007.

David L. Millman. Reducing the degree of the Apollonius diagram predicates. Presentation at REUSSI Seminar 2006, INRIA-Rocqencort, France, July 2006.

Recent Conferences Attended

Innovations in Theoretical Computer Science 2012
Canadian Conference on Computational Geometry 2011
ACM Symposium on Computational Geometry 2010
Fall school on ShApes, Algebra and Geometry 2010

Professional Affiliations

Association for Computing Machinery (ACM), 2008–Present
Mathematical Association of America (MAA), 2008–Present
Society for Industry and Applied Mathematics (SIAM), 2007–Present

Professional Service

Book Reviewer, ACM Special Interest Group Algorithms and Computational Theory (SIGACT) (2008-2012)
Referee, ACM Symposium on Computational Geometry (2009,2011-2012)
Referee, Shape Modeling International (2011-2012)
Referee, ICST Transactions on Algorithms Engineering (2011)
Referee, Canadian Conference on Computational Geometry (2011)
Referee, International Journal of Computational Geometry and Applications (IJCGA) (2010)
Referee, IEEE Computer Graphics and Applications (2009)
Referee, IEEE Robotics and Automation Magazine (2008)
Referee, International Symposium on Voronoi Diagrams in Science and. Engineering (ISVD) (2007)

Skills

Programming languages: C/C++, Fortran, Java, Mathematica, MATLAB, and Python

Graphics: OpenGL, Interface design with Java Swing and Eclipse SWT

Parallel Programming: C with MPI, CUDA, Java with CSP, OpenMP and MATLAB's distributed computing toolbox

Web development: CGI, HTML, Javascript

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Relevant Coursework: Abstract Algebra, Advanced Calculus I, Algebraic Structures, Algorithms, Artificial Intelligence, Calculus I-III, Cryptography, Compilers, Computational Geometry, Computational Topology, Euclidean and Non-Euclidean Geometry, Graphics, Machine Learning, Networking, Natural Language Processing, Modules and Linear Algebra, Motion Planning, Number Theory, Operating System Design, Parallel Computing, Physical Media, Physically-Based Modeling Simulation and Animation, Programming Languages, Scientific Computation I and II, and Unix Systems